Kennedy Space Center Environmental Health Program

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ABSTRACT: The Kennedy Space Center's environmental health organization is responsible for programs which assure its employees a healthful workplace under diverse and varied working conditions. These programs encompass the disciplines of industrial hygiene, radiation protection (health physics), and environmental sanitation/pollution control. Activities range from the routine, such as normal office work, to the highly specialized, such as the processing of highly toxic and hazardous materials.

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KSC's Environmental Health Program has a simple and straightforward objective—provide everyone a healthful workplace.

The simplicity of this statement, however, can be misleading. The Space Center is big and diversified. It has a land area of over 200 square miles, employs almost 20,000 people, and hosts approximately 2 million visitors per year. On-site facilities and organizations include well over 100 major buildings and structures and about 50 different government and contractor resident/tenant organizations. Operations range from routine institutional activities, such as office work and facility maintenance, to highly specialized prelaunch and postlanding payload, spacecraft, and Shuttle vehicle processing.

Much of the challenge facing the environmental health professional at KSC is due to a combination of factors. One is the ever-broadening base of harmful physical agents and energies, toxic substances, and restrictive regulatory requirements which must be dealt with in the workplace. Another is the unusual diversity and complexity of activities. Other factors include the indigenous pressures associated with tight schedules and one-of-a-kind hardware.

Obviously specialization and a multidisciplinary approach is needed to achieve the main environmental health objective. Organizationally the KSC Program is comprised of three basic elements: industrial hygiene, radiation protection, and environmental sanitation/pollution control. Responsibility for overall Program administration resides with the Medical and Environmental Health Office within the KSC Biomedical Operations and Research Office. The group is supervised by the environmental health officer, a physician, and is staffed by an industrial hygienist, a health physicist, and an environmental scientist, each of whom functions as a program manager for their respective discipline.

Industrial hygiene ● The Industrial Hygiene (IH) Program is designed to assure the proper recognition, evaluation, and control of exposures to hazardous chemical and physical agents in the work environment and compliance with various regulations which mandate the scope and methodology to be followed.

The space program presents some unique IH problems associated with spacecraft launch processing operations. The most significant is the safe use and handling of toxic propellants used on the Space Shuttle and satellites. Recently, the American Conference of Governmental Industrial Hygienists (ACGIH) announced its intention to reduce its published Threshold Limit Value (TLV) for exposure to monomethyl hydrazine (MMH), a commonly used spacecraft propellant, to 10 parts per billion in air, a level far below the sensitivity of readily available field detectors. NASA utilized its unique research and development resources to develop a technology enabling rapid and accurate field measurements of this air contaminant with sensitivities previously considered infeasible.

Another unusual hazardous operation performed at KSC Shuttle processing facilities is the waterproofing of thousands of heat resistant tiles on Shuttle Orbiters. The chemical dimethylethoxysilane is injected into the porous tile where it reacts with the silicates to provide the necessary water repellant characteristics. In addition to our role in monitoring the exposures of employees and determining appropriate protective measures, the IH Office also has a role in clarifying the toxicity of the substance, which is not well understood. To do this, the staff works closely with NASA toxicologists located at the Johnson Space Center who have conducted animal studies needed for assessment of the toxic effects involved.

While national attention is often focused upon hazards associated with processing and launching the Space Shuttle and its various payloads, many IH Program activities are directed toward more routine operations which pose a potential health risk to employees. An example of a typical hazard which affects almost every work place is the presence of asbestos materials in many KSC structures which requires constant oversight of facility maintenance and repair activities that may disturb these materials. As part of this function, KSC maintains an asbestos analysis capability to assess any potential hazards and the associated remedial actions needed. Special controls and requirements are assigned depending on the predicted and/or measured presence of asbestos contamination for a given situation.

Functionally, the Industrial Hygiene Officer serves as the Program's single point-of-contact for the Center and is responsible for formulation of center-wide policies and for technical consultation services. A summary of the various program elements is given in Table 1.

Table 1.—Industrial Hygiene Program Elements.

Airborne Contaminant Monitoring	Hazard Communication
Hazardous Materials Management	Emergency Response
Respiratory Protection Program	Noise Monitoring
Hearing Conservation Program	Confined Space Program
Asbestos Abatement	Lead Paint Abatement
Ergonomic Assessments	Heat Stress
Ventilation System Assessment	Indoor Air Quality

Field and technical services supporting the implementation of the IH Program are provided by the Base Operations Contractor (BOC) Environmental Health Division which maintains a staff of IH professionals. They perform a variety of support functions such as atmospheric monitoring of hazardous operations, ventilation system testing, confined space entry testing, procedure reviews, and consultation on individual projects such as asbestos abatement or refurbishment of structures painted with lead-bearing paints.

Radiation protection ● Management and administration of the Radiation Protection Program is assigned to the KSC Radiation Protection Officer, a staff health physicist. Program policy and implementation is overseen by the KSC Radiation Protection Committee, which has technical and management representation from various NASA KSC Offices. Support of day-to-day Program implementation and maintenance is provided by the Health Physics Office, an element of the Base Operations Contractor.

Most people would be surprised at the numbers and types of controlled radiation sources involved with KSC operations. Listings from a recent typical inventory, routinely conducted on a calendar quarter basis show some 3000 radioactive sources, 50 electronic radiation producing machines, 340 radiofrequency and microwave transmitters, 200 lasers, 500 ultraviolet, infrared, and high-intensity-visible optical sources, and over 1000 microwave ovens.

The majority of these are minor or low power sources representing minimal exposure hazards under normal conditions. They are controlled primarily to comply with accountability and regulatory licensing requirements. Examples include low level (millicurie/microcurie activity), solid or sealed sources used for instrument test and calibration and life sciences projects, low power 2-way radios, and Class I laser devices, such as laser printers and copiers, bar-code readers, and measuring equipment.

On the other hand, a few of them are potentially very hazardous and capable of serious, even lethal, personnel exposure levels if not properly controlled. The High Energy Radiography Facility (HERF), for example, houses a 9 Mev linear accelerator used to x-ray solid rocket motor segments for defects. This system can deliver a lethal radiation dose within six seconds to anyone in its main beam. To help prevent

such exposures the system is housed in a cell having six-foot thick concrete walls, interlocked and controlled access points, and multiple fail-safe warning and alarm systems.

Another example of major radiation sources at KSC is the isotopic power units (known as radioisotope thermoelectric generators or RTGs) used to provide in-flight electrical power to deep space planetary probes. These devices contain relatively large amounts of plutonium-238 oxide, about 11 kilograms (132,000 curies) each, and present both a continuous external radiation hazard due to the ever present mixed gamma/neutron field and a potential internal alpha radiation hazard from inhalation following an accidental breach of containment. Handling and launch of these devices requires extensive controls and emergency planning and preparation. The recently launched Galileo (1989) and Ulysses (1990) spacecraft utilize RTGs for long-term mission electrical power. Future space exploration and research plans call for the use of space nuclear reactors for both electrical power and for physical propulsion. Radiation protection planning for both ground handling and launch/landing contingency operations will be significantly expanded to address the additional control requirements associated with these next generation space nuclear devices.

KSC's Radiation Protection Program is based on three fundamental principles: centralized and uniform control and enforcement; compliance with applicable regulations, standards, and guides; and elimination or minimization of personnel exposures to levels that are below regulatory limits and are as low as reasonably achievable (ALARA).

Implementation of the Program relies heavily on a fundamental review and approval mechanism called the Radiation Use Request/Authorization process. It involves submission of specific information by the prospective user, review of the information relative to applicable requirements, assessment of the potential hazards involved, and imposition of specific controls and provisions.

The centerpiece of the Program is KSC's Broad Scope Radioactive Materials License issued by the Nuclear Regulatory Commission. It was developed to accommodate the wide variety and volume of payloads brought on by the advent of the Shuttle Program. Briefly stated, the license can handle the full range of radioisotopes, forms, and quantities typical of an ever-changing research and development effort, without having to apply for amendments every time something new is encountered. Activities under auspices of the license have had a spotless record throughout its ten-year plus lifetime.

Environmental sanitation/pollution control • The Environmental Sanitation and Pollution Control Program incorporates multifaceted compliance activities directed towards the protection of the employee and the natural environment. The Pollution Control and Sanitation Officer is delegated administration and oversight responsibility.

The sanitation aspects of the Program revolve around the traditional public health elements of food service, potable water system, and domestic wastewater surveillance. Food service surveillance encompasses the usual inspection of all places where food is stored, prepared, or offered for sale. Potable water is provided to KSC by a local municipality. Older sections of the water distribution system, some dating back to the 1960s, require frequent sampling. Domestic wastewater management involves a number of sewage treatment plants and remote area septic tank systems whose operations are closely monitored. Sanitation surveillance significantly increases during the large influx of on-site launch day visitors.

A unique aspect of the Program includes surveillance of consumables used by the astronauts at KSC before a mission. Extensive prelaunch microbiological and chemical sampling of their potable water supply is conducted to help ensure the on-orbit health of the crew. The air supplied to the crew quarters is periodically monitored for any microorganisms that may adversely affect their well-being.

A major portion of KSC's approximately 140,000 acres is managed by the United States Fish and Wildlife Service as a wildlife refuge. This refuge is particularly significant because it is home to the largest number of threatened and endangered species of any wildlife refuge in the continental United States. The Pollution Control Program plays an important role by conducting hazardous and nonhazardous waste management surveillance, permit discharge monitoring, and environmental baseline monitoring in the wildlife refuge areas.

Other hazardous waste surveillance entails close inspection of over 250 locations at the Center which generate or store hazardous waste. Operation of the KSC on-site nonhazardous waste landfill for construction and demolition debris is also inspected routinely to ensure it only receives debris it is permitted to receive. The Center also has a number of federal and state permitted discharge and release points which are monitored using strict protocols to verify they do not exceed prescribed limits.

One of the most important aspects of the Program is the baseline environmental monitoring aspects. The key to determining potential impacts is first understanding what is the ambient environmental quality. Water, soil, and air quality are routinely evaluated to identify any potential trends which may indicate a negative impact and a need to modify or change a process. For example, the soil and groundwater around the launch complexes are closely monitored to detect potential changes from the original conditions which existed. Changes are then

assessed to determine if they are natural in origin or related to activities at the site. The emphasis of this aspect of the program is in detecting and quantifying change in the natural environment and consequently identifying its origin.

Conclusion ● Overall KSC's Environmental Health Program has an excellent record in maintaining a healthful workplace for its employees and visitors for a number of years. It has been the product of aggressive and proactive administration that is aimed at staying ahead of ongoing activities and abreast of new and evolving requirements. Our plans are to maintain this approach as KSC moves into the next phases of space exploration including Space Station, Lunar Base, and the manned missions to Mars.

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